EFFECTIVENESS OF PROPRIOCEPTIVE INTEGRATION ON SENSORY-SPECIFIC BALANCE TRAINING IN OLDER ADULTS

A PROJECT WORK SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF OCCUPATIONAL THERAPY

Submitted By

Reg No. 41091211

JKK MUNIRAJA MEDICAL RESEARCH FOUNDATION
COLLEGE OF OCCUPATIONAL THERAPY
KOMARAPALAYAM – 638 183

Affiliated by

THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY
CHENNAI – 600 032

MARCH - 2011

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PRINCIPLE **EXTERNAL EXAMINER**

GUIDE **INTERNAL EXAMINER**

CERTIFICATE

This is to certify that the Project work entitled, "**EFFECTIVENESS OF PROPRIOCEPTIVE INTEGRATION ON SENSORY-SPECIFIC BALANCE TRAINING IN OLDER ADULTS"** is a bonafide compiled work carried out carried out by **Reg. No. 410911211,** Final year student, College of Occupational Therapy under J.K.K. Munirajah Medical Research Foundation, Komarapalaym - 638 183, in partial fulfillment for the award of Degree of **"Master of Occupational Therapy"** of **The Tamilnadu Dr. M.G.R. Medical University, Chennai-32.** This work was guided and supervised by **Dr.T.S.CHELLAKUMARASAMY, MBBS., DPMR., MD (PMR).,** at the Department of Occupational Therapy, **JKKMMRF, Komarapalayam.**

Mr.M.SARAVANA ROENTGEN MANI, M.I.Th.,
PRINCIPAL
M.Sc. (OT), PGDR. (OT)
J.K.K. Munirajah Medical Research Foundation,
Komarapalaym

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Dr.T.S.CHELLAKUMARASAMY, MBBS., DPMR., MD (PMR).,
Programme Director,
JKKMMRF College of Occupational Therapy,
Komarapalayam

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Reg.No:41091211

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ABSTRACT

OBJECTIVE:

To evaluate the Effectiveness of Proprioceptive integration on sensory specific balance training in older adults.

METHOD:

A quasi experimental design using simple randomized sampling of 30 older adults age from 50-60 years divided into two groups, control and experimental with each group 15 patients. The experimental group underwent treatment for 3 sessions per week for 12 weeks. Fullerton Advanced Balance scale was used to evaluate the outcome.

RESULTS:

Results shows significant improvement in balance training programme with proprioceptive integration among older adults with statistical significance present in experimental group compared to control group.

CONCLUSION:

Sensory specific Balance training programme with proprioceptive integration was found to be effective among older adults.

KEY WORDS:

Aging, Postural control, Balance Training Programme, Proprioception.

INTRODUCTION

Aging is typically associated with generalized slowing of movement (Spirduso,1975) particularly during complex motor tasks (Ketcham, Seidler, Van Gemmert & Stelmach,2002), declines in balance and postural control (Lin &Woollacott,2005), deficits in motor co-ordination (Darling, Cooke & Brown, 1989; Seidler–Dobrin, He & Stelmach, 1998; Yan,2000) and increased variability (Darling et al.,1989;Yan,Thomas, &Stelmach,1998).

Postural control depends on the ability to extract peripheral sensory-inputs, integrate this information within the central nervous system (CNS) and co-ordinate and execute an appropriate motor response. Proprioception is an essential component of this sequence of events, providing orientation information about passive and active movements and position of the joints as well as the force resulting from muscular contractions. Age-related changes in the ability to assess the contribution of proprioceptive inputs relative to those of other sensory inputs become evident under conditions in which the proprioceptive inputs are distorted and then suddenly restored.

NEED FOR THE STUDY

Balance programmes are vital for the elderly as they can reduce the number of falls and resultant injuries (Province et al 1995). This should also try to increase confidence in body movements, the range of movement and body control, and thereby increase quality of life. The purpose of our balance training programmes was therefore to push the individuals to their limit of balance and range of movement outside the everyday range of standing, sitting and supine positions. The idea was to re-establish the proprioception of extreme movements in a safe environment, and thus provide more control, confidence and ease in normal positions and dynamic movement. As the balance exercises focused on developing proprioception , many were performed with eyes open. Thus this programme was also low cost and time efficient, lasting only twelve weeks with one hour of training thrice a day per week.

AIMS & OBJECTIVES

AIM OF THE STUDY

The aim of the study is to determine whether the proprioceptive integration is effective for sensory-specific balance training in older adults.

OBJECTIVES

1. To measure the Functional Limitations by Fullerton Advanced Balance (FAB) scale.
2. To assess the effectiveness of proprioceptive integration on sensory-specific balance training in older adults.

HYPOTHESES

Null Hypotheses

The null hypothesis states that there will be no significant relationship between proprioceptive integration and sensory-specific balance training for older adults.

Alternate Hypotheses

The alternate hypotheses states that there will be significant relationship between proprioceptive integration and sensory-specific balance training for older adults.

REVIEW OF LITERATURE

Michail Doumas, et al (2010), Adaptation and Reintegration of Proprioceptive in Young and Older adults' postural control. He investigated age-related changes in adaptation and sensory reintegration in postural control without vision. In two sessions, participants adapted their posture to sway reference and to reverse sway reference conditions, the former reducing (near eliminating) and the latter enhancing (near doubling) proprioceptive information for posture by means of support-surface rotations in proportion to body sway. Participants stood on a stable platform for 3 min (baseline) followed by 18 min of sway reference or reverse sway reference (adaptation) and finally again on a stable platform for 3 min (reintegration). Results showed that when inaccurate proprioception was introduced, anterior-posterior (AP) sway path length increased in comparable levels in the two age groups. During adaptation, young and older adults reduced postural sway at the same rate. On restoration of the stable platform in the reintegration phase, a sizeable aftereffect of increased AP path length was observed in both groups, which was greater in magnitude and duration for older adults. His findings illustrate age-related slowing in participants' postural control adjustments to sudden changes in environmental conditions. The results implicate sensory reweighting as a specific mechanism highly sensitive to age-related decline[1].

Kelly.P.Westlake, et al (2007), Sensory-specific balance training in older adults: effect on Proprioceptive reintegration and cognitive demands. Participants were randomly assigned to a balance exercise group (n_17) or a falls prevention education group (n_19). The primary outcome measure was the center-of- pressure (COP) velocity change score. This score represented the difference between COP velocity over 45 seconds of quiet standing and each of six 5-second intervals following proprioceptive perturbation through vibration with or without a secondary cognitive task. Clinical outcome measures included the Fullerton Advanced Balance (FAB) Scale and the Activities-specific Balance Confidence (ABC) Scale. Assessments were conducted at baseline, postintervention, and at an 8-week follow-up. Therfore the results showed that improvements also were seen on the FAB Scale and were maintained at follow-up[2].

Westlake et al., (2007) Sensory- specific balance training in older adults: effect on position, movement, velocity sense at the ankle. This study indicates that balance training program of the 64 older volunteers who responded to study advertisements, 45 subjects met the study criteria and were randomly assigned to either the balance exercise group or the falls prevention education group (Fig. 2). By the end of the 8-week interventions, 36 subjects remained, with 17 and 19 participants in the balance exercise and falls prevention education programs, on three proprioceptive measures at the ankle in older adults, he suggested that velocity sense improved after a sensory-specific balance training intervention[3].

Fernando Riberio, et al (2007), Aging effects on joint Proprioception: the role of physical activity in proprioception preservation. This study indicates that regular physical activity seems to be a beneficial strategy to preserve proprioception and prevent falls among older subjects. He suggested that regular physical activity can attenuate age- related decline in proprioception[4].

D.E. Adamo, et al (2007), Influence of Age and Physical activity on Upper limb proprioceptive Ability. He examined both young and older adults, (active, sedentary) right handed adults using a wrist position matching task that varied in terms of processing demands. Older sedentary showed greater errors and performed movements less smoothly than older active adults. He suggested that performing tasks specific to the upper limbs may further reduce age related declines in proprioception[5].

James.W.Bellew et al, (2005) this investigation reports the effects of a simple, short-term balance training program on dynamic balance in healthy older women. Subjects included 11 healthy women (75.6 ± 6.4 years) who participated in biweekly, 15-minute balance training sessions for 5 weeks, and 10 age-matched women (71.2 ± 9.1 years) who served as controls. Balance training involved medial-lateral and anterior-posterior movements and bilateral partial squats while standing on semi-compressible foam roller devices. Dynamic balance was quantified using functional reach in the forward, left, and right directions, and a lower extremity reach test. Therefore the results showed that significant increases were observed in the balance trained group: 25% in functional reach right (P = 0.014) and left (P < 0.001) and 16% in lower extremity reach (P = 0.001). No change was noted in the control group[6].

Jenifer .C. Nitz, et al (2004) The Efficacy of a specific balance strategy training programme for preventing falls among older people. The specific balance strategy intervention group showed significantly more improvement in functional measures than the control group (P=0.034). Separate group analyses indicated significantly improved performance in functional motor ability and most clinical balance measures for the balance group (P<0.04). The control group only improved in TUG and TUGcog. Therefore, the results provide evidence that all participants achieved a significant reduction in falls. Specific balance strategy training using workstations is superior to traditional exercise classes for improving function and balance[7].

K.R.Thompson, et al (2003) evaluate the effect of resistance training on proprioception, community dwelling older women completed a three-month exercise study. A resistance training (RT) group (N=19) underwent supervised weight training three times per week while a non-strength trained control (NSTC) group (N=19) performed range-of-motion activities that mimicked the movements of the RT group without the benefit of muscle loading. Subjects were evaluated at baseline, 6, and 12 weeks for strength and proprioception. Muscular strength was assessed by measuring the subject's one repetition maximum performance on four different exercises.Static proprioception was measured by the subject's ability to reproduce a target knee joint angle while dynamic proprioception was measured by the subject's ability to detect passive knee motion. The RT group made significant strength improvements compared to the NSTC group. Proprioception was significantly improved in both groups by 6 weeks. Our findings suggest that improvements in proprioception can be obtained via regular activity that is independent of heavy muscle loading[8].

Gerome C. Gauchard, et al (2003), Influence of Regular Proprioceptive and Bioenergetic physical activities on balance control in elderly women. Balance disorders increase considerably with age due to a decrease in posture regulation quality, and are accompanied by a higher risk of falling. Conversely, physical activities have been shown to improve the quality of postural control in elderly individuals and decrease the number of falls. This study was to evaluate the impact of two types of exercise on the visual afferent and on the different parameters of static balance regulation. Static postural control was evaluated in 44 healthy women aged over 60 years. Among them, 15 regularly practiced proprioceptive physical activities (Group I), 12 regularly practiced bioenergetic physical activities (Group II), and 18 controls walked on a regular basis (Group III). Group I participants displayed lower sway path and area values, whereas Group III participants displayed the highest, both in eyes-open and eyes-closed conditions. Group II participants displayed intermediate values, close to those of Group I in the eyes-open condition and those of Group III in the eyes-closed condition. Visual afferent contribution was more pronounced for Group II and III participants than for Group I participants. Conclusions. Proprioceptive exercise appears to have the best impact on balance regulation and precision. Besides, even if bioenergetic activity improves postural control in simple postural tasks, more difficult postural tasks show that this type of activity does not develop a neurosensorial proprioceptive input threshold as well, probably on account of the higher contribution of visual afferent[9].

Gauchard GC, et al. (1999). Age and lack of physical activities may both be responsible for poor balance control. Conversely, physical activities may modulate postural control in elderly individuals. We examined which type of exercise might prove most beneficial to retain or regain proper balance. Nineteen healthy subjects, aged over 60, regularly practicing proprioceptive (group I) or bioenergetic (group II) physical activities and 21 controls only walking on a regular basis, were studied. All were submitted to a dynamic posturographic test and to a test evaluating lower limbs muscular strength. Control individuals displayed the poorest balance and muscular performance. Group I subjects had the best postural control with average muscular strength. In group II, muscular strength was significantly increased, but balance control was of poor quality. Proprioceptive exercise therefore appears to have the best impact on balance control[10].

RELATED LITERATURE

Aging

Aging involves gradual, progressive and spontaneous deterioration of most physiological functions (Rundgren 1991 Beers and Berkow,2000). Although many studies on the process of aging have revealed declines in numerous sensory and motor functions in elderly individuals, how and why we age remains unclear. The several contemporary theories concerning aging can be divided into two categories: theories that maintain that aging is genetic is predetermined, advancing linearly with increasing age; and hypothesis concerning non-genetic secondary aging, which claim that this process is mainly due to environmental factors such as diseases and catastrophes that result in rapid,non-linear decline of behavioral functions. Obviously genetic and secondary factors interact in conjunction with the aging process (Rundgren 1991, Shumway-cook and Woollacott,2000;Beers and Beerkow, 2000).

Postural control

Daily living requires that the central nervous system regulates and co-ordinates multi-joint movements and postural control during one and the same task. Virtually every movement that an individual makes contains of postural components, which stabilize the body, and prime mover components, designed to achieve a particular movement (Shumway-cook and Woollacott,2000).Postural control is the complex process requiring the integration of many bodily systems.(Massion, 1994; Horak and Macpherson, 1996).

There is still no generally accepted definition of postural control nor is there any clear consensus with respect to the underlying mechanisms. Previously, postural control was often defined as the ability to maintain the body's centre of mass(COM)within the boundaries of the base of support(BOS).However this definition is not sufficient, since it is not applicable to all types of daily activities (Tang and Woollacott,2004).For example, in connection with dynamic tasks such as walking, the COM passes outside the medial border of the supporting leg rather than passing through the BOS.

The current view is that postural control in an upright standing position involves both static and dynamic components (Horak and Makpherson, 1996).The goals are to maintain the body's position in space for stability and orientation. Postural orientation is defined as the ability to maintain a relationship between the different segments of the body as well as between the entire body and the environment that is appropriate for performance of the task at hand; while postural stability is the ability to maintain the body in spatial equilibrium under both static and dynamic conditions (Horak and Makpherson, 1996; Shumway-cook and woollacott,2000). From this perspective good postural control means integration of posture and voluntary movements in such a manner that the individual is able to carry out a voluntary task safely (Task and Woollacott, 2004).

Falls and the future

The elderly are highly susceptible to falls. The consequences of this are significant because falls often result in bone fractures, hospitalization and reduced independence and thus initiate negative feedback loops that can ultimately lead to death.(Spirduso,1995).The problem is especially important to address for the 21st century because the elderly population is on the increase. This will undoubtedly put a strain on health care, and falls will be a significant factor since they are leading cause of accidental death (Office for National statistics,1998).In attempts to reduce falls and injuries, resulting from falls, researchers have identified balance as a risk factor (Nickens 1985).Balance is maintained by inputs from the somatosensory, vestibular and visual system with all three providing spatial orientation input,(Wade and Jones,1997). Proprioception is part of the somatosensory input, and is often overlooked. Proprioception acuity in the elderly can decline due to injury, inactivity and motor unit reorganisation. It is this input that this investigation focuses on re-training to improve is accuracy.

Postural sway

One of the most important predictors of falls is postural sway. Fall Control Systems, LLC uses the dynamic posturography system by Vestibular Technologies CAPS EQ system to evaluate postural sway. Control of postural sway when standing involves continual muscle activity (primarily the calf muscles), and requires an integrated reflex response to visual, vestibular, and somatosensory inputs.

Factors found to be highly correlated with increased postural sway include:

- Reduced lower extremity muscle strength
- Reduced peripheral sensation
- Poor near visual acuity
- Slowed reaction time

Measurement of postural sway in a standing person has been reported to be a useful predictor of falls in older people. An inability to maintain balance on the foam at all is associated with falling. There is some evidence that peripheral sensation is the most important sensory system in the regulation of standing balance in older adults. The maintenance of postural stability is a highly complex skill that's dependent on the interplay of a vast number of neurophysiological and biomechanical variables. Normal aging leads to a decreased ability to control postural stability in standing on either one or two legs. As walking is mostly done with one leg, the importance of maintaining good control over functional systems is of critical importance. Unexpected changes in the terrain can be a major hazard in those who have lost functional qualities. Balance tests in isolation do not have the ability to fully determine the risk of falling and a battery of tests should explore the dynamics of the factors involved in the risk of falling.

Exercise has been shown to successfully prevent falls in the elderly (Province et al,1995).There are also a number of studies that have focused on interventions to improve balance, but the interventions and measurements used vary widely, and often the training was not specifically designed for balance. Currently most improvements in balance are achieved indirectly by programmes focused on other aspects of exercise (e.g. Strength and endurance) and as a consequence, such gains are not maximized, other programmes that are more focused on balance (e.g. computerized balance training) have proven to be beneficial, but many are laboratory based and/or focus on static balance.

An important distinction to be made between training programmes (and their assessment) is whether they are focused on static or dynamic balance. Static balance is the ability to maintain posture when stationary, while dynamic balance is the ability to maintain balance while in motion(Woollacott and Tang 1997). As 30-70 percent of all falls in the elderly are due to slips, trips and misplaced footing (Topper et al 1993), dynamic balance is likely to be of prime importance. It has been shown that static balance mechanisms are ineffective for improving dynamic balance (Winstein 1989), suggesting that dynamic balance should be the focus for elderly balance interventions. Existing programmes do not appear to target or maximize dynamic balance.

Physiological changes related to ageing include, for example, cognitive impairment (Nevitt,1989) reductions in muscle strength(Daubney,1999;Doherty1993), proprioception(skinner1984), joint range of motion (Mills 1994) and reaction time(stelmach1994), and changes in sensory systems (Berg 1989).These factors potentially negatively affect balance control and impact on the functional ability of the older person.

Diminished ability to maintain balance may be associated with an increased risk of falling(Berg 1989).In older adults, falls commonly leads to injury, loss of independence, associated illness and early death(Baker 1985;Berg 1989;Tinetti 1988).An extensive review of published trials of interventions to reduce the incidence of falling in elderly people has been published(Gillespie,2004).Although some exercise interventions with balance and muscle strengthening components have been shown to reduce falls(Campbell 1997;Robertson 2001;Wolf 1996),it is not clear which element or combination of elements is necessary to achieve this result.

Biofeedback and visual feedback have been used to improve balance control by addressing internal factors that are thought to contribute towards balance (Geiger 2001; Walker 2000).However such interventions have tended to focus on single components of balance control; a multifactorial approach may be more appropriate.

Proprioception

Proprioception was originally defined by Sherrington in 1906 as "the perception of joint and body movement as well as position of the body, or body segments, in space". Proprioception means "sense of self". In the limbs the proprioceptors are sensors that provide information about joint angle, muscle length and tension, which is integrated to give information about the position of the limb in space. The muscle spindle is one type of proprioceptor that provides information about changes in muscle length. The Golgi tendon organ is another type of proprioceptor that provides information about changes in muscle tension.

The Somatosensory system provides information related to body position by proprioceptors and exteroceptive receptors. The proprioceptive receptors are located in muscles, tendons and joints (Enbom 1990, Jantti 1993), and they give information about the position of the limbs and the body and the distension of the respective muscles. Proprioceptors include muscle spindles (type Ia and II), Golgi tendon organs (Ib) and joint receptors (McComas 1996). Exteroceptive information is derived from different type of pressoreceptors on the foot sole. Exteroceptive receptors are located in the cutaneous and subcutaneous tissue (Johansson & Vallbo 1980). The major types of cutaneous receptors are Meissner corpuscles and Merkel disks, located closest to the skin surface, and Ruffini ending and Pacinian corpuscles, located deeper in the skin (Latash 1998)

While the receptors in joint capsules give information about the movements and positions of the body parts relative to each other, their role in postural control has not been fully defined yet. The muscle spindles give information about the changes in muscle length and tension (dynamic stretch), and they can also be activated by passively stretching the entire muscle. In addition to an afferent system, the intrafusal fibers in the muscle spindles also receive an efferent input via γ -motor neuron (Enoka 1994). The pressoreceptors detect the body sway, whereas the mechanoreceptors can determine both the site and velocity of an indentation of the skin, as well as acceleration and pressure changes (Johansson & Vallbo 1980, Magnusson *et.al.* 1990).

There are some essential inputs for postural control during stance produced by proprioception. First, the information from ankle joints should be recognized, as it is affected by the movement of the centre of gravity, resulting in torque around the ankle joint. Second, the information from the neck muscles gives important references concerning head movement in relation to the trunk. And third, it has been suggested that the eye muscles reflect the eye position in relation to the head (Spirduso 1995).

Proprioception- perception of stimuli relating to position, posture, equilibrium or internal condition. Receptors (nerve endings)in skeletal muscles and on tendons provide constant information on limb position and muscle action for co-ordination of limb movements represents an essential component of postural control, providing orientation information about movement and position of the joints and muscles.

The propriosensory system helps the motor system to maintain equilibrium on a reflex, automatic basis. According to Winter, "Because 2/3 of our body mass is 2/3 of body height above the ground, we are an inherently unstable system, unless a control system is operating." (Winter 1995) In response to a sudden load, "the muscles will respond rapidly to stabilize the body, i.e., they will try to maintain balance and posture."(Wilder,et.al. 1996). An age-related change in this sensation constitutes an important risk factor for falls, Postural instability and impaired function.

Integration of balance training

Balance is defined as the ability to maintain the projection of the body's centre of mass (CoM) within manageable limits of the base of support, as in standing or sitting, or in transit to a new base of support, as in walking (Winter 1995). The base of support is composed of the area between all points of contact of the body with another surface; points of contact also include extensions of the body through assistive devices e.g. walking sticks and frames. Balance is an integral component of daily (functional) activities, however, balance control is very complex and multifactorial. The task being undertaken and the environment in which it is taking place both affect an individual's ability to control balance, by altering the biomechanical and information processing needs (Huxham 2001). Balance may be measured when the body has a constant, or static, base of support, or during movement from one base of support to another. It can be analyzed directly by quantifying the position of the CoM in relation to the base of support. Alternatively, balance can be measured indirectly through observation, self reporting or other reporting methods such as objective tests of functional activities.

However, the ability to undertake functional activities is complex and multifaceted involving not only balance but other factors such as strength, proprioception and integrity of the neuromuscular system, pain, vision and in some instances fear of falling.

Both proprioception and Balance Training have been advocated to restore motor control to the motor extremity. In the clinic, the term ‘‘balance” is often used without a clear definition. It is important to remember that Proprioception and balance are not the same. Proprioception is a precursor of good balance and adequate function. Balance is the process by which we control the Body’s center of Mass with respect to the base of support whether it is stationary or moving.

Berg has attempted to define balance in three ways; the ability to maintain a position, the ability to voluntarily move, and the ability to react to a perturbation. All three of these components of balance are important in the maintenance of upright posture. Static balance refers to an individual’s ability to maintain a stable antigravity position while at rest by maintaining the center of mass within the available base of support. Dynamic balance involves automatic postural responses to the disruption of the center of mass position. Reactive postural responses are activated to recapture stability when an unexpected force displaces the center of mass.

Postural sway is a commonly used indicator of the integrity of the postural control system. Horak defined postural control as the ability to maintain equilibrium and orientation in the presence of gravity.

Researchers measure postural sway as either the maximum or the total excursion of centre of pressure while standing on a force plate. Little change is noted in healthy adults in quiet standing, but the frequency, amplitude and total area of sway increase with advancing age or when vision or when proprioceptive inputs are altered.

In order to maintain balance, the body must make continual adjustment. Most of what is currently known about postural control is based upon stereotypical postural strategies activated in response to anteroposterior perturbation. Horak and Nashner et al., described several different strategies used to maintain balance. These strategies include the ankle, hip and stepping strategies. These strategies adjust the body's center of gravity so that the body is maintained within the base of support to prevent the loss of balance or falling. There are several factors that determine which strategy would be the most effective response to postural challenge; speed and intensity of the displacing forces, characteristics of the support surface, and magnitude of the displacement of the centre of mass. The automatic postural responses can be categorized as a class of functionally organized long-loop responses that produce muscle activation that brings the body's centre of mass into a state of equilibrium. Each of the strategies has reflex, automatic and volitional components that interact to match the response to the challenge.

Small disturbances in the center of gravity can be compensated by motion at the ankle. The ankle strategy repositions the centre of mass after small displacements due to slow-speed perturbations, which usually occur on a large, firm, supporting surface. The oscillations around the ankle joint with normal postural sway are an example of the ankle strategy. Anterior sway of the body is counteracted by gastrocnemius activity, which pulls the body posterior. Conversely, posterior sway of the body is counteracted by contraction of the anterior tibial muscles. If the disturbance in the center of gravity is too great to be counteracted by motion at the ankle, the patient will use a hip or stepping strategy to maintain the center of gravity within the available base of support when the center of mass is near the edge of the sway envelope. The hip strategy is usually in response to a moderate or large postural disturbance, especially on an uneven, narrow or moving surface.

METHODOLOGY

RESEARCH QUESTION

Whether proprioceptive Integration on sensory specific balance training is effective in older adults

OPERATIONAL DEFINITION OF VARIABLES

Independent variable

Occupational Therapy Intervention (i.e.) Proprioceptive Integration.

Dependent variable

Sensory-specific balance training.

RESEARCH DESIGN

The present study was two groups, control and experimental with pre and post test, quasi experimental design.

Experimental group:	Pre test	Intervention	Post test
Control group	Pre test		Post test

SAMPLE SIZE

The sample size was 30 subjects.

- 15 subjects - Experimental group
- 15 subjects - Control group.

SAMPLING TECHNIQUE

Simple Randomized sampling was taken to determine the effectiveness of the program.

SETTING AND DURATION

Setting	-	Tuticorin
Duration	-	12 months.

POPULATION OF THE STUDY

The population of the study consists of men and women.

CRITERIA OF SAMPLING SELECTION

Inclusion Criteria

1. Normal Older adult population
2. Both male and female.
3. Age groups between 50-60 years.

Exclusion criteria

1. People with any neurological Disorders.
2. People with any respiratory, central or peripheral vascular, metabolic or musculoskeletal disease.
3. People with any Lower extremity disorders (e.g. deformities, OA Knee, and other related orthopedic problems.)

MEASUREMENT TOOLS USED

The older adults were diagnosed to measure their functional limitations by Fullerton Advanced Balance (FAB) scale.

Initially, the primary investigator assessed the balance skills by using the 5-point scale.

Procedure

30 participants were randomly assigned to two groups; experimental and control group. The experimental participants attended a 12-week balance training programme with one hour thrice a week.

Primary Outcome Measure

The primary outcome measure was the single limb stance in balance board change score. This score represented the single limb standing in balance board and each of 3- five second interval without any secondary task. Clinical outcome measures included the Fullerton Advanced Balance Scale.

Balance Training Programme

The balance training programme involved static Balance activities and dynamic Balance Activities to heighten positional sense, confidence in movement and enhance their awareness of body alignment and posture.

Static Balance Activities

- ❖ The most basic activity use to determine a client's level of proprioception is the tandem stance balance.
- ❖ Ask the client to stand on a level surface with one foot in front of the other, heel to toe.
- ❖ Arms at sides or raised-whichever is easier. He should be able to stand still in this position for 30 seconds with his eyes open. Next, have the client close his eyes and stand still in the same position for 30 seconds.
- ❖ The single limb stance is also a good activity for improving the proprioception skills.
- ❖ Have the client stand still on one leg for 30 seconds with both eyes open and arms at his sides or raised, without allowing the elevated foot to touch the ground. Once he can accomplish this, have him close his eyes while maintaining the same position and still for another 30 seconds.

Balance Board

Balance Board is also effective for improving the balance skills. In the beginning, have the client simply stand on the balance board using both feet. Once the client is being comfortable, she/he can begin learning to balance on the balance board using just one foot.

To increase the level of difficulty either on the floor or on a balance board, use a weighted ball such as a medicine ball.

Play a game of catch with your client or have to continually move the ball from one part of her body to another.

Moving the ball from left to right using both hands while twisting her trunk.

Switching the ball from one hand to the other at the midline of her body.

The other activities included

- Standing or walking on various support surfaces such as a balance board, foam or narrow beam.
- Standing in a tandem position.
- A semi-tandem position on one leg or in a feet together position.

The experimental group was under intervention on proprioceptive integration where as the control group had not under gone any specific interventions. After a period of 3 months of interventions the post test evaluation was done for both groups and the scores are calculated.

FULLERTON ADVANCED BALANCE SCALE

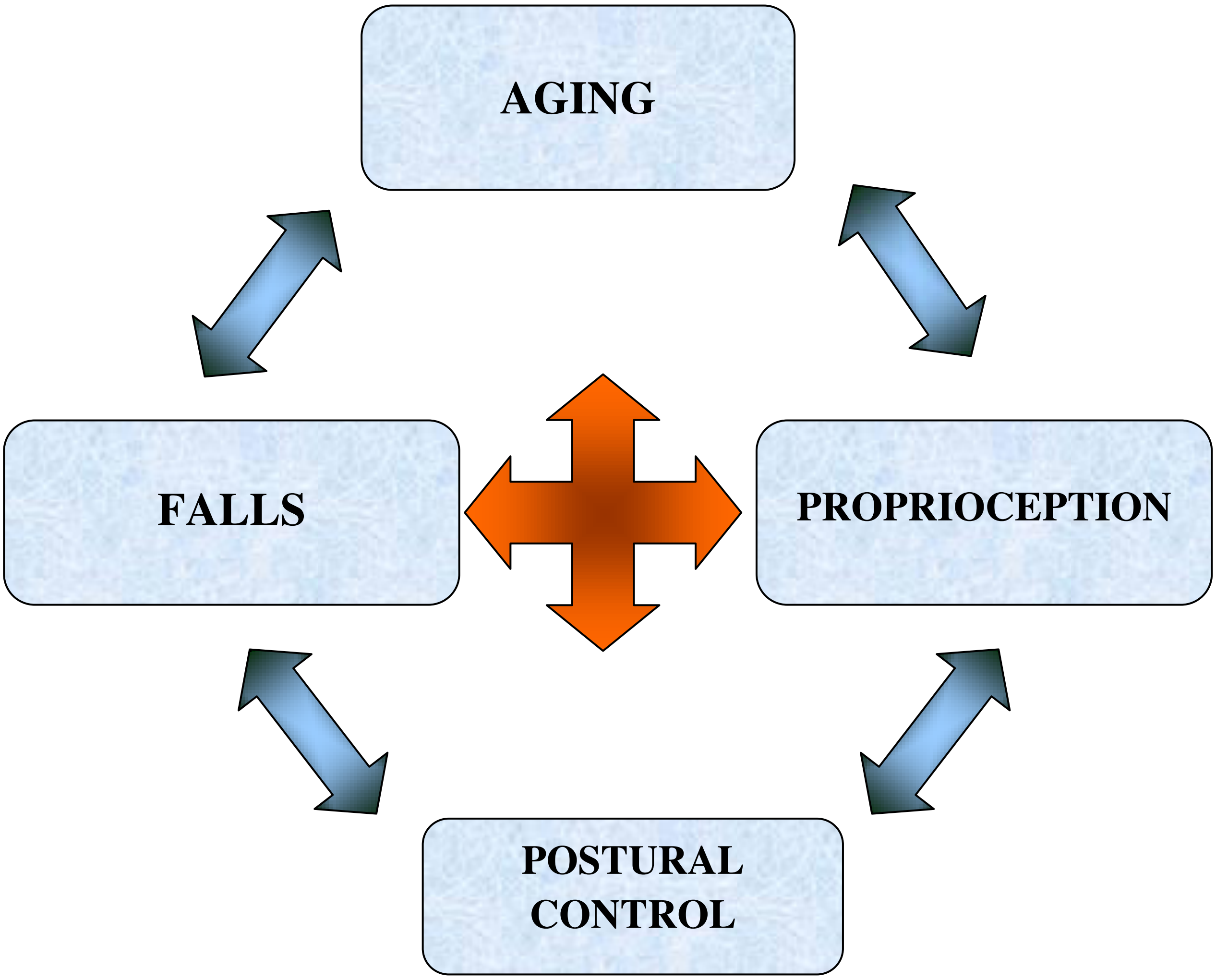
The Fullerton Advanced balance scale (FAB) (Rose, Lucchese & Wiersma 2006) is a physical performance assessment designed to assist practitioners and clinician in evaluating the multiple dimensions of balance in higher functioning older adults. Each of 10 FAB scale items examines how well balance activities are performed in various sensory environments and/or requires different task demands. This scale can be used to identify functional limitations associated with impairments in the visual, somatosensory and vestibular systems as well as the neuromuscular and musculoskeletal systems. Impairments in one or more of the sensory systems will adversely affect anticipatory, adaptive and/or reactive postural responses required of older adults who are living in the community. Once clinicians have identified the functional limitations and possible underlying impairments associated with balance, they can use this information to design a client-specific intervention aimed to at improving balance and lowering fall risk (Rose,2003; Rose et al 2006).

Previous investigations have demonstrated that the FAB scale is valid and reliable balance measure (Rose et al 2006) .The scale’s criterion validity has also been established. The scale was found to be moderately correlated (0.75) with the Berg balance scale (BBS), another multiple item scale which was originally designed to evaluate the balance in lower functioning older adults in a geriatric rehabilitation setting (Berg, Wood-Dauphinee, Williams and Gayton, 1989). A moderate correlation between the total FAB scale and BBS total score suggested that the two scales measured a similar construct in populations with different functional abilities. The total FAB scale score exhibits high test-retest reliability (r =0.94 to 0.97,p<0.01;h co-efficient =0.90 or greater; Rose et al

2006).Furthermore the predictive validity of the scale has recently been established as it relates to faller status (Hernandez &Rose ,2008).In this study, an inverse linear relationship was reported to exist between the total FAB scale score achieved and the level of fall risk; for every one point increase in the total FAB scale score, fall risk declined by 8%.Additionally,a score of 25 or lower out of 40 was associated with a heightened risk of falling. The sensitivity of the scale was shown to be 74.6% while the specificity reported was 52.6% (Hernandez &Rose, 2008).

The discriminant validity of the scale has also been demonstrated for different clinical populations. Significant differences in balance performances were evident between a group of women (ages 30 to 60) receiving Taxane chemotherapy and an age matched healthy group of women who did not receive the same therapy (p=0.017; Wampler, Topp, Miaskowski, Byl, Rugo&Hamel, 2007). Additionally, the FAB scale may be sensitive to change in balance performance. A significant change in mean FAB scale scores was reported for a group of 19 older adults (ages 60 to 89) who completed an intervention based on the Alexander's technique (Baston & Barker 2008).

CONCEPTUAL FRAMEWORK



a. Proprioception declines during aging process and decrease in postural control which causes frequent occurrences of falls.
b. Intervention proceeds, regular physical activity may attenuate the proprioceptive decline, which gives the postural control stability and prevention of falls.

STATISTICAL ANALYSIS & RESULTS

The data were tabulated and analyzed using descriptive and inferential statistics. The performance of each test by the subject before and after treatment was noted separately.

SPSS package was used to assess the means of standard deviation of all the parameters.

The following formulate were used to find out the mean and standard deviations.

X=∑x/n where X is the given variable

$$SD = \sqrt{\frac{\sum (x-\bar{x})^2}{(n-1)}}$$

The scores were statistically analyzed using the paired t-test to find the significant changes before and after treatment. The mean of each data was plotted on a Bar graph using Ms- office unit.

The analysis method is given below

$$t = \frac{|d|}{\left(\frac{s}{\sqrt{n}}\right)}$$

TABLE – 1

STATISTICAL ANALYSIS FOR PRE EVALUATION OF CONTROL GROUP AND EXPERIMENTAL GROUP

GROUP	N (n=30)	MEAN	SD	"t" value	Sig (2-tailed)
Control	15	30.2	16.85	0.17	Not significant P > 0.05
Experimental	15	30.67	15.24		

Independent "t" test was used to compare the pretest mean scores of control and experimental group (30.2, 30.67). The results showed that there was no statistically significant difference (t=0.17, p> 0.05) in pre test mean scores between control and experimental group. Therefore the two group were similar in standing in a single limb stance in balance board before intervention.

GRAPH:1 – COMPARISON BETWEEN CONTROL GROUP AND EXPERIMENTAL GROUP IN PRE EVALUATION

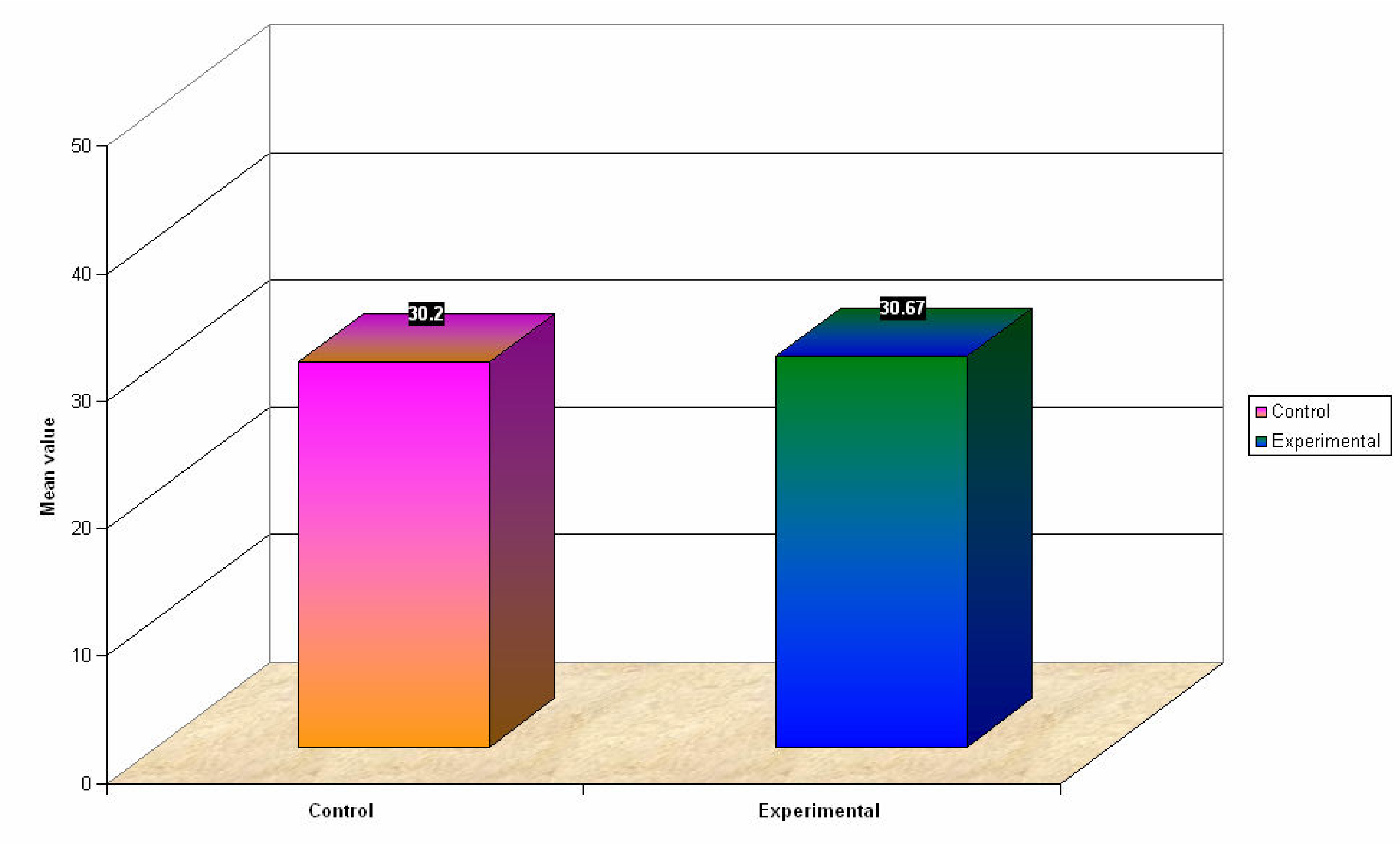


TABLE – 2

STATISTICAL ANALYSIS BETWEEN PRE AND POST EVALUATION OF CONTROL GROUP

	N	**Mean**	**SD**	**“t” Value**	**Sig (2-tailed)**
Pre-Evaluation / Post Evaluation	15	7.6	7.1	4.17	Significant ($P< 0.05$)

Paired “t” test was used to compare the pre test and post test mean scores of control group. The mean value for the pre test and post test mean score is 7.6. The results showed that there was a statistically significant difference (t=4.17) in pre test and post test mean scores of control group.

GRAPH:2 – COMPARISON BETWEEN PRE AND POST EVALUATION IN CONTROL GROUP

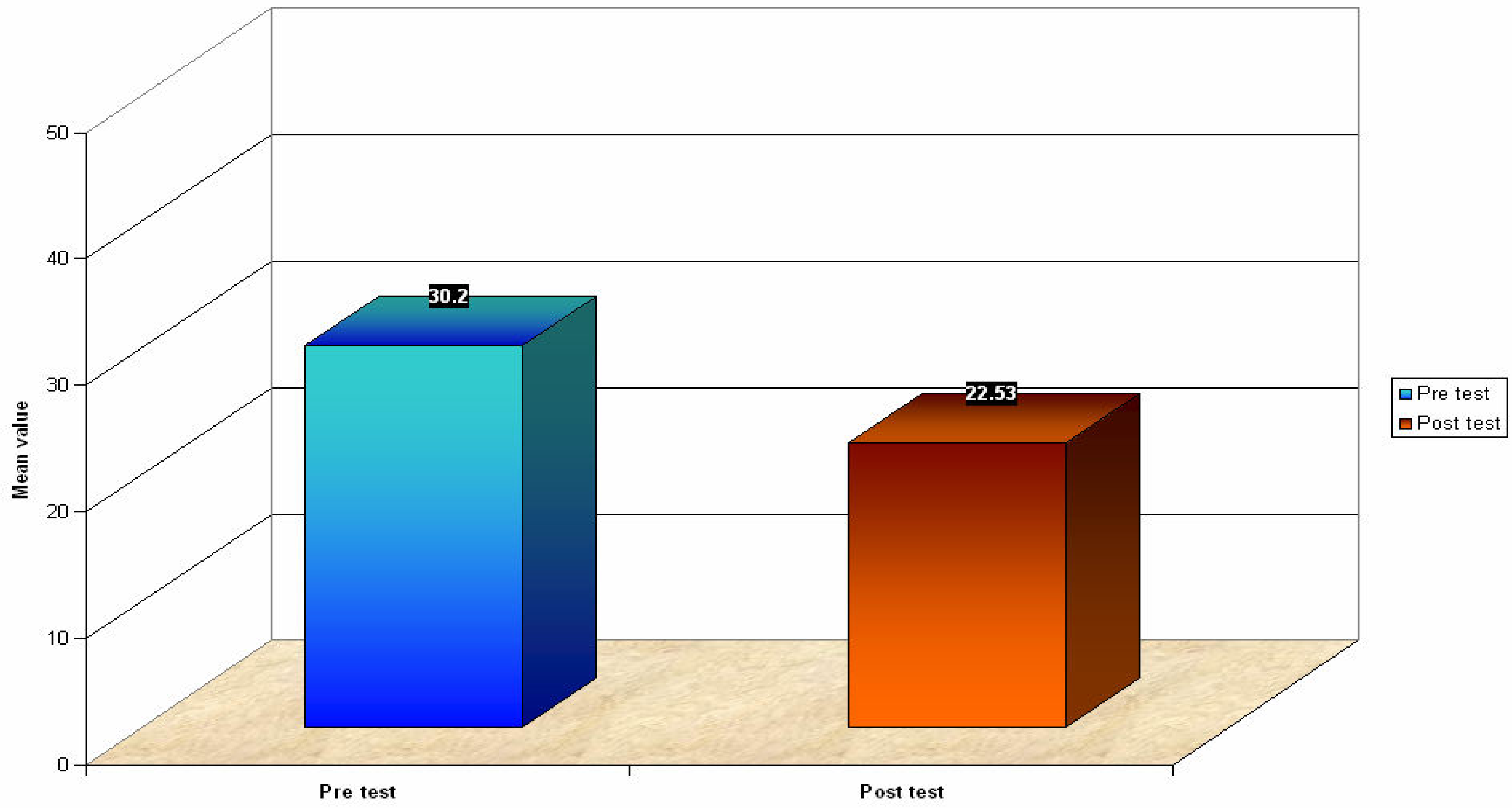


TABLE – 3

STATISTICAL ANALYSIS BETWEEN PRE AND POST EVALUATION OF EXPERIMENTAL GROUP

	N	**Mean**	**SD**	**"t" Value**	**Sig (2-tailed)**
Pre-Evaluation	15	9.6	4.9	7.64	Significant (P< 0.05)
Post Evaluation					

Paired "t" test was used to compare the pre test and post test mean scores of experimental group. The mean value for the pre and post evaluation is 9.6. The results showed there was statistically highly significant difference and the "t" value obtained for the difference in score is 7.64.

GRAPH – 3: COMPARISON BETWEEN PRE AND POST EVALUATION IN EXPERIMENTAL GROUP

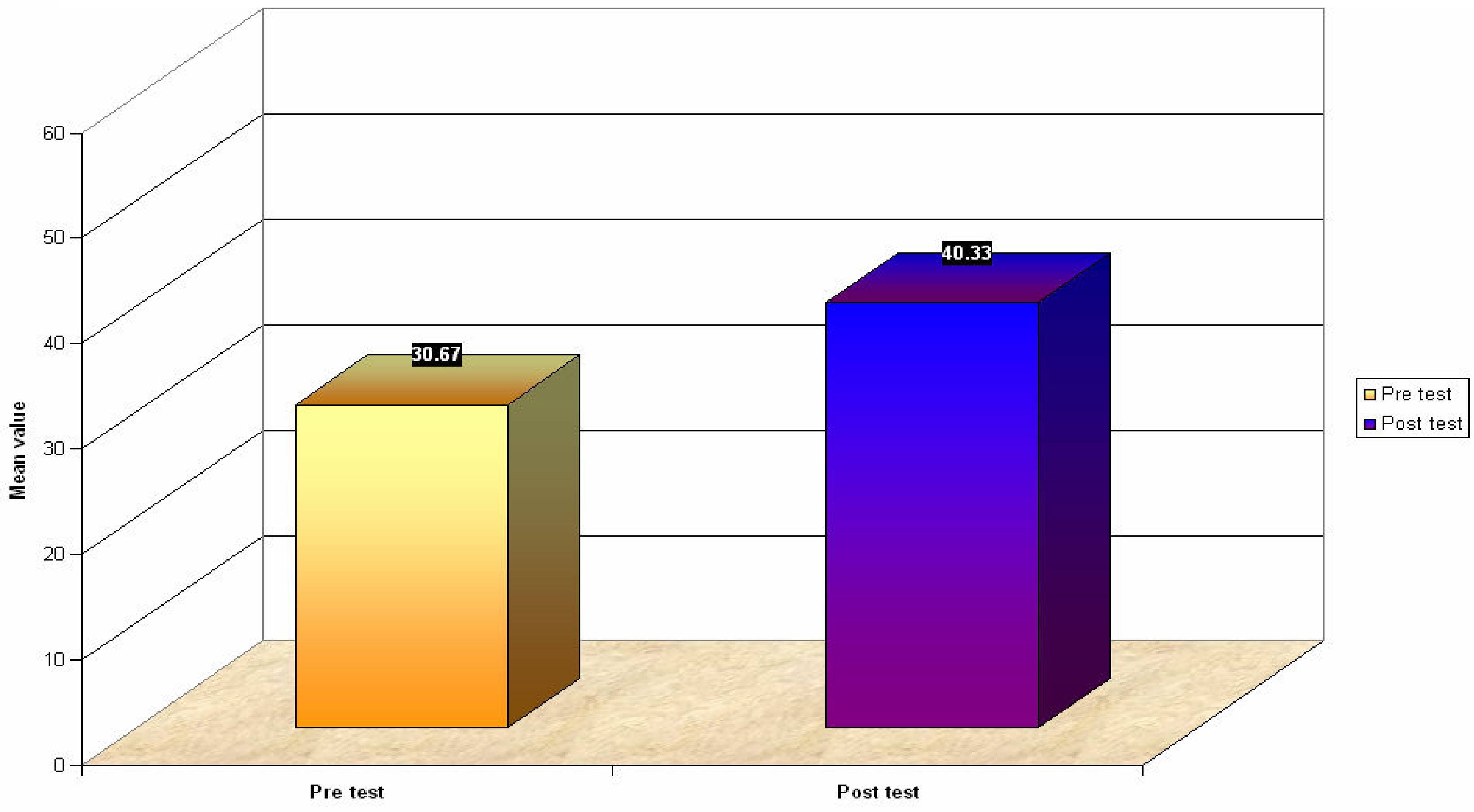


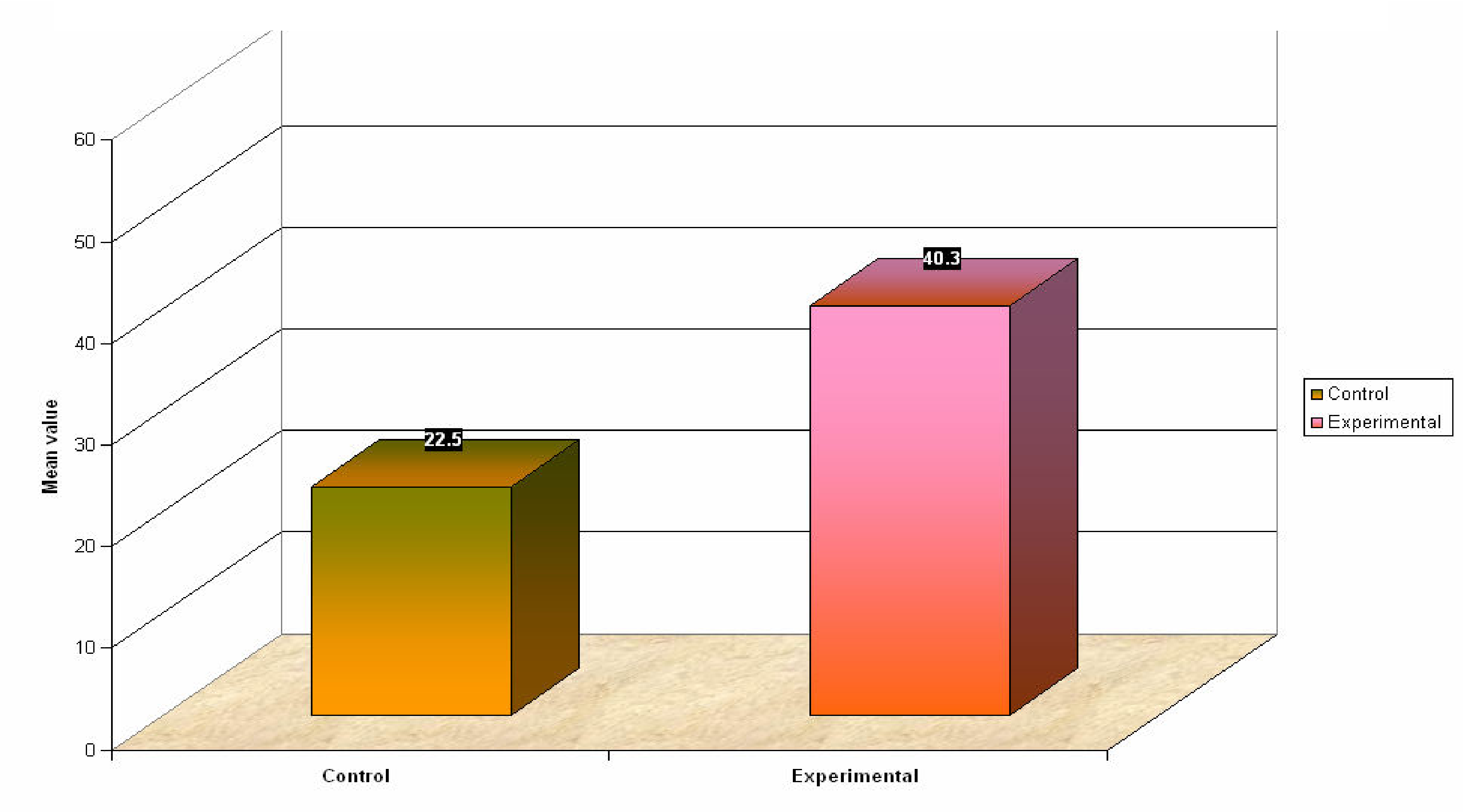
TABLE - 4

STATISTICAL ANALYSIS FOR POST- EVALUATION OF CONTROL GROUP AND EXPERIMENTAL GROUP

GROUP	N (n=30)	MEAN	SD	"t" value	Sig (2-tailed)
Control	15	22.5	12.09	3.14	Significant $P < 0.05$
Experimental	15	40.3	17.15		

Independent "t" test was used to compare the post test mean scores of control group and experimental group (22.5, 40.3). The results showed that there was highly statistical significant difference (t=3.14) in post test mean scores between control and experimental group. Therefore it can be seen that using proprioceptive integration increase balance strategy in older adults.

GRAPH:4 – COMPARISON BETWEEN CONTROL GROUP AND EXPERIMENTAL GROUP IN POST EVALUATION



DISCUSSION

Throughout the human lifespan the functions of several physiological systems dramatically change, including proprioception. Impaired proprioception leads to less accurate detection of body position changes increasing the risk of fall. The aim of the study is to determine the effectiveness of proprioceptive integration among sensory specific balance training in older adults.

The intervention was done over a period of 3 months with older adults from Tuticorin town. A total of 30 older adults were selected for the study were randomly selected to the experimental or control group, till the number of 15 subjects were reached in each group Pre evaluation was done for both groups separately. The pre evaluation results of two groups were statistically calculated to find out the difference among the samples in the group. There was no statistically significant different in pre test scores between the groups.

The experimental group was under sensory specific balance training with proprioceptive integration where as the control group had not undergone any specific intervention. After a period of three months of intervention the post test evaluation was done for both groups the scores were calculated and results analyzed.

The result shows in Table 1 and Graph 1 (i.e.) comparison of pre test statistical mean scores of control and experimental group showed no significant different. Both groups were similar before intervention.

Table 2 and Graph 2 results show that comparison of Pre test and Post test mean scores of control group which were statistically significant, probably because of proprioceptive integration. Proprioceoptive integration plays a vital role in treatments and might be beneficial to retain or regain balance (Gauchard et al, 1999).

Table 3 and graph 3 shows that comparisons of Pre test and Post test mean scores of experimental group which were highly statistically significant as compared to control group.

Finally Table 4 and Graph 4 show that comparison of post test mean scores of control group and experimental group were statistically significant at the level of $P<0.05$. This means that using proprioceptive integration for improving balance training result in a higher level of increasing balance among experimental group.

Similar results are supported by a review done by Katherine E.Forth et al who suggested that Proprioceptive Balance training intervention for Elderly community dwellers significantly improved both their static and dynamic balance and confidence compared with the walking intervention and help to improve their balance and reduce the risk of falling.

Also supported by Gauchard et al, (1999) who investigated the effects of different types of exercise on postural control and balance of aged individuals and concluded that the proprioception can be “trained” and that regular exercise of proprioceptive nature might be beneficial to retain or regain balance.

Statistically, the result shows significant relationship between sensory based balance and proprioceptive integration of older adults between pre evaluation and post evaluation. Statistically, data showed that without proprioception, the performing movement is delayed and decline in balance abilities.

Thus this study disproves the null hypotheses that there will be no significant relationship between proprioceptive integration and sensory-specific balance training for older adults.

RECOMMENDATIONS FOR FUTURE STUDY

The current study has been done on Proprioceptive integration for improving balance of older adults of both male and female. This study can also be enhanced by using other techniques like Visual integration and Vestibular integration for improving balance in older adults.

This study was done with eyes open with smaller sample size. This study can also be done with larger samples. Also, this study can be done with eyes closed for middle aged people to improve the component of balance and reduce the risk factor for falls and also, this study can be done for single (i.e. either male or female) sex group.

SUMMARY AND CONCLUSION

The study was conducted over a period of 3 month. Totally 30 older adults were selected for this study, 15 people were control group, and 15 people were experimental group. Pre and post test were conducted both groups by using 5 point scale. Experimental group underwent occupational therapy intervention, whereas control group had not undergone any treatment.

The results shows that there were significant improvements in the experimental group than control group after trained in proprioceptive integration.

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APPENDIX

FULLERTON ADVANCED BALANCE SCALE

Patient's Name: ________________________ Date: ________________

Test Equipment:

Stop watch; 36" ruler; pen or pencil; 6" bench; metronome; 2 airex pads and one or more 12 inch lengths of non-slip material.

1) Standing with Feet Together and Eyes Closed.

Equipment: None

Verbal Instructions:

"Bring your feet together, and fold your arms across your chest. Close your eyes when you are ready and remain as steady as possible until I instruct you to open your eyes."

Grading: Please mark the lowest category that applies.

0 - Unable to obtain the correct standing position independently.

1 - Able to obtain the correct standing position independently but unable to maintain the position or keep the eyes closed for more than 10 seconds.

2 - Able to maintain the correct standing position with eyes closed for more than 10 seconds but less than 30 seconds.

3 - Able to maintain the correct standing position with eyes closed for 30 seconds but requires close supervision.

4 - Able to maintain the correct standing position with eyes closed for 30 seconds safely.

2) Reaching Forward to Retrieve an Object (pencil) Held at Shoulder Height with Outstretched Arm.

Equipment: Pencil, 12 inch ruler

Verbal Instructions:

"Try and lean forward to take the pencil from my hand and return to your starting position without moving your feet from their present position."

Grading: Please mark the lowest category that applies.

0 - Unable to reach the pencil without taking more than 2 steps.

1 - Able to reach the pencil but needs to take 2 steps.

2 - Able to reach the pencil but needs to take 1 step.

3 - Can reach the pencil without moving the feet but requires supervision.

4 - Can reach the pencil safely and independently without moving the feet.

3) Turn 360 Degrees in a Right and Left Direction.

Equipment: None.

Verbal Instructions:

"Turn around in a full circle, pause, and then turn in a second full circle in the opposite direction."

Grading: Please mark the lowest category that applies.

0 - Needs manual assistance while turning.

1 - Needs close supervision or verbal cueing while turning.

2 - Able to turn 360 degrees but takes more than 4 steps in both directions.

3 - Able to turn 360 degrees but unable to complete in 4 steps or less in one direction.

4 - Able to turn 360 degrees safely and takes 4 steps or less in both directions.

4) Step Up and over a 6” Bench

Equipment: 6 inch high bench. (18 X 18 inch stepping surface)

Verbal Instructions:

“Step up onto the bench with your right leg; swing your left leg directly up and over the bench and step off the other side. Repeat in the opposite direction with your left leg as the leading leg.”

Grading: Please mark the lowest category that applies.

0 - Unable to step onto the bench without loss of balance or manual assistance.

1 - Able to step up onto the bench with lead leg but trailing leg contacts bench or swings around the bench during swing-through phase in both directions.

2 - Able to step up onto the bench with lead leg but trailing leg contacts

bench or swings around bench during swing-through phase in one direction.

3 - Able to correctly complete the step up and over in both directions but requires close supervision in one or both directions.

4 - Able to correctly complete the step up and over in both directions safely and independently.

5) Tandem Walk

Equipment: Masking tape.

Verbal Instructions:

“Walk forward along the line, placing one foot directly in front of the other such that the heel and toe are in contact on each step forward. I will tell you when to stop”.

Grading: Please mark the lowest category that applies. An interruption refers to a lateral step, failure to achieve heel-toe position on certain steps, or loss of balance.

0 - Unable to complete 10 steps independently.

1 - Able to complete the 10 steps with more than 5 interruptions.

2 - Able to complete the 10 steps with 5 or less interruptions.

3 - Able to complete the 10 steps with 2 or less interruptions.

4 - Able to complete the 10 steps independently and with no interruptions.

6) Standing on One Leg

Equipment: Stopwatch.

Verbal Instructions:

"Fold your arms across the chest, lift your preferred leg off the floor (without touching your other leg), and stand with eyes open as long as you can.

Grading: Please mark the lowest category that applies.

0 - Unable to try or needs assistance to prevent falling.

1 - Able to lift leg independently but unable to maintain position for more than 5 seconds.

2 - Able to lift leg independently and maintain position for at least 5 but less than 12 seconds.

3 - Able to lift leg independently and maintain position for at least 12 but less than 20 seconds.

4 - Able to lift leg independently and maintain position for the full 20 seconds.

7) Standing on Foam with Eyes Closed

Equipment: Stopwatch; two AirexTM pads with one length of non-slip material placed between the two pads and one additional length of non-slip material between the floor and first pad if the test is being performed on a non-carpeted surface.

Verbal Instructions:

"Step up onto the foam and stand with feet shoulder width apart. Fold your arms over your chest, and close your eyes when you are ready. I will tell you when to open your eyes."

Grading: Please mark the lowest category that applies.

0 - Unable to step onto foam and/or maintain standing position independently with eyes open.

1 - Able to step onto foam independently and maintain standing position but unable or unwilling to close eyes.

2 - Able to step onto foam independently and maintain standing position with eyes closed for 10 seconds or less.

3 - Able to step onto foam independently and maintain standing position with eyes closed for more than 10 seconds but less than 20 seconds.

4 - Able to step onto foam independently and maintain standing position with eyes closed for 20 seconds.

8) Two-footed Jump for Distance

Equipment: 36 inch ruler; piece of masking tape.

Verbal Instructions:

"Try and jump with two feet as far but as safely as you can".

Grading: Please mark the lowest category that applies.

0 - Unable to attempt or attempts to initiate two-footed jump but one or both feet do not leave the floor.

1 - Able to initiate two-footed jump but one foot either leaves the floor or lands before the other.

2 - Able to perform two-footed jump but unable to jump further than the length of their own feet.

3 - Able to perform two-footed jump and achieve a distance greater than the length of their own feet.

4 - Able to perform two-footed jump and achieve a distance greater than twice the length of their own feet.

9) Reactive Postural Control

Equipment: None.

Verbal Instructions: "Slowly lean back into my hand until I ask you to stop."

Grading: Please mark the lowest category that applies.

0 - Unable to maintain upright balance, no observable attempt to step- requires manual assistance to restore balance.

1 - Unable to maintain upright balance, takes two or more 2 steps and requires manual assistance to restore balance.

2 - Unable to maintain upright balance, takes two or more 2 steps but is able to restore balance independently.

3 - Unable to maintain upright balance, takes 1-2 steps but is able to restore balance independently.

4 - Unable to maintain upright balance, but is able to restore balance independently with one step only.

TOTAL SCORE = 36

MASTER CHART

EXPERIMENTAL GROUP

S.NO	PRE-EVALUATION	POST - EVALUATION
1	28 SEC	37 SEC
2	45 SEC	47 SEC
3	35 SEC	54 SEC
4	18 SEC	26 SEC
5	9 SEC	15 SEC
6	35 SEC	41 SEC
7	67 SEC	80 SEC
8	19 SEC	21 SEC
9	32 SEC	44 SEC
10	14 SEC	24 SEC
11	19 SEC	29 SEC
12	40 SEC	55 SEC
13	18 SEC	32 SEC
14	35 SEC	40 SEC
15	46 SEC	60 SEC

MASTER CHART

CONTROL GROUP

S.NO	PRE-EVALUATION	POST - EVALUATION
1	43 SEC	22 SEC
2	16 SEC	16 SEC
3	27 SEC	19 SEC
4	28 SEC	25 SEC
5	51 SEC	47 SEC
6	46 SEC	33 SEC
7	25 SEC	20 SEC
8	16 SEC	12 SEC
9	22 SEC	17 SEC
10	14 SEC	12 SEC
11	5 SEC	4 SEC
12	62 SEC	45 SEC
13	50 SEC	30 SEC
14	13 SEC	12 SEC
15	35 SEC	24 SEC